REMARKS

Claims 1-15, as amended, are presented for examination. Reconsideration is respectfully requested.

Claims 11-12, 14 stand rejected under 35 USC 112 as being indefinite. Claims 11 and 12 have been amended in order to obviate the Examiner's rejection. In particular, process steps are explicitly stated.

Claim 14 is believed to be definite as stated. Claim 14 depends from claims 12 and 13 because claim 14 calls upon the "volume fraction" of claim 12 and the "total surface area of asphaltene aggregates" of claim 13.

Claim 1 stands rejected under 35 USC 102 as being anticipated by Ganeshan, U.S. 5,843,303, or Sung et al., U.S. 5,207,891. In addition, claim 2 stands rejected under 35 USC 103(a) as being unpatentable over Ganeshan, U.S. 5,843,303, or Sung et al., U.S. 5,207,891, in view of Jones et al., U.S. 5,969,237.

The present invention has two aspects. The first is a method including the step of disaggregating asphaltenes in petroleum oils and mixtures thereof by heating such that the aggregates remain soluble. This aspect of the invention includes three limitations: (1) disaggregation of asphaltenes (2) mild heating of the petroleum oils to disaggregate the asphaltenes and (3) the disaggregated asphaltenes remain soluble in the petoleum oils.

The second aspect of the invention is a method including the step of determining the presence of asphaltene aggregates by small angle neutron scattering (SANS). In this aspect of the present invention, the presence of asphaltenes in petroleum oils are determined by SANS. Petroleum oil is a complex mixture of hydrocarbons and many other constituents. The hydrocarbon content may be as high as 97% w/w or as low as 50% w/w, see e.g. James G. Speight, "The Chemistry and Technology of Petroleum," 3rd edition, Marcel Dekker, Inc. (1999).

Crude oil includes asphaltenes. These asphaltenes aggregate to form large molecules. As stated in the Speight book, cited above, on page 480:

> The pronounced tendency of asphaltenes to form *aggregates* in hydrocarbon solution is one of their most characteristic traits. Thus, while a number of experimental methods indicate that isolated asphaltene monomers have an *average* molecular weight on the order of 1500 to 2500 (vapor pressure osmometry in polar solvents), numerous methods show that asphaltenes associate spontaneously in most hydrocarbon media, resulting in observed molecular weights of 10,000 or more.

The cited references do not make the present invention obvious. The references and their differences with the present invention are discussed below.

A. Ganeshan, U.S. 5,843,303

Ganeshan discloses a process to remove asphaltenes from residuum oils using a steam stripping technique. Ganeshan aggregates the asphaltenes into an asphaltene phase leaving a separate solvent-deasphalted oil (DAO) phase. The separation involves heating to separate the two phases. The DAO phase is then removed by contacting with a light hydrocarbon solvent (see col. 1, lines 31-45, and col. 2, lines 33-55). Therefore,

(1) Ganeshan does not disaggregate asphaltenes,

(2) Ganeshan does not heat the oil to disaggregate asphaltenes, and

(3) Ganeshan does not have disaggregated asphaltenes remain soluble in the petroleum oils by heating

B. Sung et al., U.S. 5,207,891

Sung et al. discloses compounds that will stabilize asphaltenes in bituminous liquids, that is, keep the asphaltenes in solution. In order to test his stabilizing compounds, he takes a drop of the mixture and places the drop in filter paper. The filter paper and drop is heated for testing using the ASTM D 2781 test method. Therefore,

(1) Sung does not disaggregate the asphaltenes by heating. Sung disaggregates by chemical compound.

(2) Sung does not heat the oil. Sung heats one drop for testing.

(3) Sung does not keep the asphaltenes soluble in the oil by heating. Sung keeps the asphaltenes soluble by a chemical dispersant.

C. Jones et al., U.S. 5,969,237

Jones describes an acoustic method for probing asphaltene agglomeration in hydrocarbon liquids, a much different method than the present invention. However, in the background of his patent, Jones refers to a paper that measures asphaltene particles. The reference in col. 2, lines 19-29 indicates that SANS is a known technique for examining asphaltenes dispersed in 1-methy-naphthalene-D10. This is a deuterated hydrocarbon solvent. That is, the hydrogen atom have been replaced by deuterium. This is not a petroleum oil nor a refinery process stream. The present invention uses SANS for non-deuterated hydrocarbons that are found in refinery streams. It is not obvious that SANS could be used to probe asphaltenes in non-deuterated oils.

A more important deficiency in the reference is that Jones says (col. 2, lines 24-28):

> ....The study concentrated on small, "basic", asphaltene particles and reported that larger particles, which might be

important to macroscopic properties, could not be measured by today's small angle scattering instruments...

As quoted above from the Speight book, asphaltenes agglomerate in petroleum to produce large molecules. The reference cited in the Jones Patent measured asphaltenes not asphaltene agglomerates. In fact, the reference cited in Jones says that it is not possible to measure asphaltene agglomerates.

Thus,

(1) the reference in Jones does not measure asphaltene agglomerates

(2) the reference in Jones does not measure asphaltenes in petroleum, and

(3) the reference in Jones says that measuring asphaltene agglomerates with SANS is impossible.

Clearly, the cited references do not disclose heating to disaggregate asphaltenes nor do they disclose SANS to determine asphaltene aggregation. Applicants respectfully request that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

Ronald D Hartman

Attorney for Applicant(s)
Registration No. 27,796
Telephone No. (908) 730-3645

☐ Pursuant to 37CFR 1.34(a)

ExxonMobil Research and Engineering Company
(formerly Exxon Research and Engineering Company)
P. O. Box 900
Annandale, New Jersey 08801-0900

RDH:jmw (2/18/03)

VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims

1. (Amended) A method [to disaggregate] comprising disaggregating asphaltenes in petroleum oils and mixtures of petroleum oils, and/or refinery streams [comprising] by mild heating, the disaggregated asphaltenes remaining soluble in the petroleum oils and mixtures of petroleum oils and/or refinery process streams.

11. (Amended) A method to estimate the volume fraction of asphaltene aggregates, ϕ_{agg}, in incompatible petroleum oil and/or refinery process stream mixtures comprising determining the [from] difference between I_L, the low-q plateau intensity corresponding to the asphaltene particles, and I_{HS}, the intensity for perfect hard spheres in the absence of aggregation, wherein I_L, and I_{HS} are determined at different volume fractions of mixing, ϕ_m.